Having thus defined the invention, the following is claimed:

1. An electric arc welder for performing a given weld process with a selected A.C. pulse current waveform performed between an electrode and a workpiece, said current waveform including a positive segment and a negative segment, with at least one segment including a peak current and background current, said welder comprising: a power source with a controller having a digital processor including a program to calculate the real time power factor of the weld current and weld voltage, said program including an algorithm to calculate the rms weld voltage, the rms weld current and the average power of said power source; a circuit to multiply said rms current by said rms voltage to produce an rms power level; a circuit to divide said average power by said rms power to create a value representing the actual real time power factor of said power source; and, a circuit to adjust said background current to maintain said power factor at a given level.

2. An electric arc welder as defined in claim 1 wherein said controller includes a wave shaper having an input with a value determining the shape of said waveform and an error circuit for comparing said actual real time power factor with a desire power factor to create a corrective value and a circuit to direct said value to said input of said wave shaper whereby said actual real time power factor is held at said desired power factor.

3. An electric arc welder as defined in claim 2 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

4. An electric arc welder as defined in claim 1 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

5. An electric arc welder as defined in claim 4 wherein said background current is adjusted in magnitude.

6. An electric arc welder as defined in claim 4 wherein said background current is adjusted in length.

7. An electric arc welder as defined in claim 3 wherein said background current is adjusted in magnitude.

8. An electric arc welder as defined in claim 3 wherein said background current is adjusted in length.

9. An electric arc welder as defined in claim 2 wherein said background current is adjusted in magnitude.

10. An electric arc welder as defined in claim 2 wherein said background current is adjusted in length.

11. An electric arc welder as defined in claim 1wherein said background current is adjusted in magnitude.

12 An electric arc welder as defined in claim 1wherein said background current is adjusted in length.

13. An electric arc welder as defined in claim 12 including a circuit to control heat of said weld process by adjusting said given level.

14. An electric arc welder as defined in claim 11 including a circuit to control heat of said weld process by adjusting said given level.

15. An electric arc welder as defined in claim 6 including a circuit to control heat of said weld process by adjusting said given level.

16. An electric arc welder as defined in claim 5 including a circuit to control heat of said weld process by adjusting said given level.

17. An electric arc welder as defined in claim 2 including a circuit to control heat of said weld process by adjusting said given level.

18. An electric arc welder as defined in claim 1 including a circuit to control heat of said weld process by adjusting said given level.

19. An electric arc welder for performing a given weld process with a selected A.C. pulse current waveform performed between an electrode and a workpiece, said current waveform including a positive segment and a negative segment, with at least one segment including a peak current and background current, said welder comprising: a power source with a controller having a digital processor including a program to calculate the real time power factor of the weld current and weld voltage, said program including an algorithm to calculate the rms weld voltage, the rms weld current and the average power of said power source; a circuit to multiply said rms current by said rms voltage to produce an rms power level; a circuit to divide said average power by said rms power to create a value representing the actual real time power factor of said power source; and, a circuit to adjust said peak current to maintain said power factor at a given level.

20. An electric arc welder as defined in claim 19 wherein said controller includes a wave shaper having an input with a value determining the shape of said waveform and an error circuit for comparing said actual real time power factor with a desire power factor to create a corrective value

and a circuit to direct said value to said input of said wave shaper whereby said actual real time power factor is held at said desired power factor.

21. An electric arc welder as defined in claim 20 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

22. An electric arc welder as defined in claim 19 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

23. An electric arc welder as defined in claim 22 wherein said peak current is adjusted in magnitude.

24. An electric arc welder as defined in claim 22 wherein said peak current is adjusted in length.

25. An electric arc welder as defined in claim 21 wherein said peak current is adjusted in magnitude.

26. An electric arc welder as defined in claim 21 wherein said peak current is adjusted in length.

27. An electric arc welder as defined in claim 20 wherein said peak current is adjusted in magnitude.

28. An electric arc welder as defined in claim 20 wherein said peak current is adjusted in length.

29. An electric arc welder as defined in claim 19 wherein said peak current is adjusted in magnitude.

30. An electric arc welder as defined in claim 19 wherein said peak current is adjusted in length.

31. An electric arc welder as defined in claim 30 including a circuit to control heat of said weld process by adjusting said given level.

32. An electric arc welder as defined in claim 24 including a circuit to control heat of said weld process by adjusting said given level.

33. An electric arc welder as defined in claim 23 including a circuit to control heat of said weld process by adjusting said given level.

34. An electric arc welder as defined in claim 20 including a circuit to control heat of said weld process by adjusting said given level.

35. An electric arc welder as defined in claim 19 including a circuit to control heat of said weld process by adjusting said given level.

36. An electric arc welder for performing a pulse welding process with a selected waveform performed between an electrode and workpiece, said waveform having a peak current and a background current, said welder comprising: a power source with a waveform generator having a control signal input with a value determining the shape of said waveform; a controller with a comparator program with a first input representative of the actual power factor of said power source, a second input representing a desired power factor and an output signal directed to said control input of said wave shape generator wherein said actual power factor is held at said desired power factor by adjusting said background current of said waveform.

37. An electric arc welder as defined in claim 36 including a device to manually adjust said desired power factor for adjusting the heat of said weld process.

38. An electric arc welder as defined in claim 37 including a control circuit for holding the rms current of said power source at a desired set value as said heat is adjusted.

39. A method of controlling an electric arc welder for performing a given pulse weld process with a selected waveform performed by a power source between an electrode and workpiece, said waveform having a peak current and a background current, said method comprising:

(a) calculating the actual power factor of said power source using the rms current and rms voltage;

(b) selecting a desired power factor for said power source;

(c) obtaining an error signal by comparing said actual power factor of power source to said desired power factor of the power source; and,

(d) adjusting background current of said waveform by said error signal whereby said actual power factor is maintained at said desired power factor.

40. The method as defined in claim 39 including manually adjusting said desired power factor to control the heat of said weld process.

41. A method as defined in claim 40 including holding said rms current constant as said desired power factor is adjusted.

42. A method as defined in claim 41 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

43. A method as defined in claim 40 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

44. A method as defined in claim 39 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

45. An electric arc welder for performing a pulse welding process with a selected waveform performed between an electrode and workpiece, said waveform having a peak current and a background current, said welder comprising: a power source with a waveform generator having a control signal input with a value determining the shape of said waveform; a controller with a comparator program with a first input representative of the actual power factor of said power source, a second input representing a desired power factor and an output signal directed to said control input of said wave shape generator wherein said actual power factor is held at said desired power factor by adjusting said peak current of said waveform.

46. An electric arc welder as defined in claim 45 including a device to manually adjust said desired power factor for adjusting the heat of said weld process.

47. An electric arc welder as defined in claim 46 including a control circuit for holding the rms current of said power source at a desired set value as said heat is adjusted.

48. A method of controlling an electric arc welder for performing a given pulse weld process with a selected waveform performed by a power source between an electrode and workpiece, said waveform having a peak current and a background current, said method comprising:

(a) calculating the actual power factor of said power source using the rms current and rms voltage;

(b) selecting a desired power factor for said power source;

(c) obtaining an error signal by comparing said actual power factor of power source to said desired power factor of the power source; and,

(d) adjusting peak current of said waveform by said error signal whereby said actual power factor is maintained at said desired power factor.

49. The method as defined in claim 48 including manually adjusting said desired power factor to control the heat of said weld process.

50. A method as defined in claim 49 including holding said rms current constant as said desired power factor is adjusted.

51. A method as defined in claim 50 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

52. A method as defined in claim 49 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

53. A method as defined in claim 48 wherein said waveform is created by a number of current pulses occurring at a frequency of at least 18 kHz with a magnitude of each pulse controlled by a wave shaper.

54. An electric arc welder for performing a given weld process with a selected current waveform outputted by a high switching speed inverter power source creating an arc voltage and arc current between an electrode and w workpiece, said waveform comprising a number of closely spaced current pulses, said welder operated in a voltage mode, with the voltage controlled by an error circuit having an error output signal generated by the difference between a first input with a signal representing the desired or set voltage for at least a portion of said waveform and a second input with a signal representing the sum of the arc voltage and the arc current multiplied by a slope constant and a DSP program to reduce said error output signal by adjusting the voltage of said waveform.

55. An electric arc welder as defined in claim 1 wherein said slope constant is in the range of 0-10%.

56. An electric arc welder as defined in claim 55 wherein said slope constant is about 5%.

57. An electric arc welder as defined in claim 54 wherein said slope constant is about 5%.

58. An electric arc welder as defined in claim 57 including a second error circuit having a second error output signal generated by the difference between a first input with a signal representing the minimum desired current and a second input with a signal representing the arc current and a DSP program to maintain said second error signal positive with said arc current equal to or greater than said minimum current.

59. An electric arc welder as defined in claim 56 including a second error circuit having

a second error output signal generated by the difference between a first input with a signal representing the minimum desired current and a second input with a signal representing the arc current and a DSP program to maintain said second error signal positive with said arc current equal to or greater than said minimum current.

60. An electric arc welder as defined in claim 55 including a second error circuit having a second error output signal generated by the difference between a first input with a signal representing the minimum desired current and a second input with a signal representing the arc current and a DSP program to maintain said second error signal positive with said arc current equal to or greater than said minimum current.

61. An electric arc welder as defined in claim 54 including a second error circuit having a second error output signal generated by the difference between a first input with a signal representing the minimum desired current and a second input with a signal representing the arc current and a DSP program to maintain said second error signal positive with said arc current equal to or greater than said minimum current.

62. An electric arc welder as defined in claim 61 including a third error circuit having a third error output signal generated by the difference between a first input with a signal representing the maximum current of said power source and a second input with a signal representing the arc current and a DSP program to maintain said third error signal negative with said arc current equal to or less than said maximum current.

63. An electric arc welder as defined in claim 60 including a third error circuit having a third error output signal generated by the difference between a first input with a signal representing the maximum current of said power source and a second input with a signal representing the arc current and a DSP program to maintain said third error signal negative with said arc current equal to or less than said maximum current.

64. An electric arc welder as defined in claim 59 including a third error circuit having a third error output signal generated by the difference between a first input with a signal representing the maximum current of said power source and a second input with a signal representing the arc current and a DSP program to maintain said third error signal negative with said arc current equal to or less than said maximum current.

65. An electric arc welder as defined in claim 58 including a third error circuit having a third error output signal generated by the difference between a first input with a signal representing the maximum current of said power source and a second input with a signal representing the arc current and a DSP program to maintain said third error signal negative with said arc current equal to or less than said maximum current.

66. An electric arc welder as defined in claim 57 including a third error circuit having a third error output signal generated by the difference between a first input with a signal representing the maximum current of said power source and a second input with a signal representing the arc current and a DSP program to maintain said third error signal negative with said arc current equal to or less than said maximum current.

67. An electric arc welder as defined in claim 56 including a third error circuit having a third error output signal generated by the difference between a first input with a signal representing the maximum current of said power source and a second input with a signal representing the arc current and a DSP program to maintain said third error signal negative with said arc current equal to or less than said maximum current.

68. An electric arc welder as defined in claim 55 including a third error circuit having a third error output signal generated by the difference between a first input with a signal representing the maximum current of said power source and a second input with a signal representing the arc current and a DSP program to maintain said third error signal negative with said arc current equal to or less than said maximum current.

69. An electric arc welder as defined in claim 54 including a third error circuit having a third error output signal generated by the difference between a first input with a signal representing the maximum current of said power source and a second input with a signal representing the arc current and a DSP program to maintain said third error signal negative with said arc current equal to or less than said maximum current.

70. An electric arc welder as defined in claim 69 wherein said error signals are digital.

71. An electric arc welder as defined in claim 61 wherein said error signals are digital.

72. An electric arc welder as defined in claim 55 wherein said error signals are digital.

73. An electric arc welder as defined in claim 54 wherein said error signals are digital.

74. An electric arc welder as defined in claim 69 wherein said weld process is submerged arc.

75. An electric arc welder as defined in claim 61 wherein said weld process is submerged arc.

76. An electric arc welder as defined in claim 55 wherein said weld process is submerged arc.

77. An electric arc welder as defined in claim 54 wherein said weld process is submerged arc.

78. An electric arc welder as defined in claim 77 wherein said weld process is AC.

79. An electric arc welder as defined in claim 69 wherein said weld process is AC.

80. An electric arc welder as defined in claim 61 wherein said weld process is AC.

81. An electric arc welder for performing a given weld process with a selected current waveform outputted by a high switching speed inverter power source creating an arc voltage and an arc current between an electrode and a workpiece, said waveform comprising a number of closely spaced current pulses, said welder operated in a voltage mode and having a digital signal processor with a control circuit to generate a voltage/current load line, said circuit subtracts from said voltage a slope controlled by the arc current multiplied by a slope constant.

82. An electric arc welder as defined in claim 81 wherein said slope constant is in the range of 0-10%.

83. An electric arc welder as defined in claim 81 wherein said slope constant is about 5%.

84. An electric arc welder as defined in claim 81 wherein said weld process is submerged arc.

85. An electric arc welder as defined in claim 81 wherein said weld process is AC.

86. An operating system for an electric arc welder including a high switching speed inverter power source for creating an arc voltage and arc current between an electrode and a workpiece, said operating system regulating the arc voltage with an error circuit to create an error output and having a first input with a signal representing the set voltage and a second input representing the sum of the actual arc voltage and the actual arc current multiplied by a slope constant and a DSP program to reduce said error output by adjusting the voltage output of said inverter power source to change said actual arc voltage.

87. An operating system as defined in claim 86 wherein said slope constant is in the range of 0-10%.

88. An operating system as defined in claim 86 wherein said slope constant is in the range of 0-5%.

89 An operating system defined in claim 87 including a second error circuit having a second error output signal generated by the difference between a first input with a signal representing the minimum desired current and a second input with a signal representing the arc current and a DSP program to maintain said second error signal positive with said arc current equal to or greater than said minimum current.

90. An operating system as defined in claim 89 including a third error circuit having a third error output signal generated by the difference between a first input with a signal representing the maximum current of said power source and a second input with a signal representing the arc current and a DSP program to maintain said third error signal negative with said arc current equal to or less than said maximum current.

91. An operating system as defined in claim 87 including a third error circuit having a third error output signal generated by the difference between a first input with a signal representing the maximum current of said power source and a second input with a signal representing the arc current and a DSP program to maintain said third error signal negative with said arc current equal to or less than said maximum current.